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COMPARISON OF THE STRESSFULNESS OF HARVESTING BROILER CHICKENS BY MACHINE AND BY HAND

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Abstract 1. The procedures of manual and machine catching acted as short-term stressors, and induced a state of fear in 8-week-old broiler chickens.

2. The heart rate of birds caught by both methods rose to similar high values but that of birds caught by machine returned to near normal rates more quickly, suggesting that they were less stressed.

3. The duration of tonic immobility, a response which increases with fearfulness, was much longer in manually-caught birds.

4. These results suggest that stress could be reduced and welfare improved by catching and picking up broiler chickens by a carefully designed machine, rather than by hand.

INTRODUCTION

Between 10 and 30% of broilers are damaged during transportation immediately before slaughter (Gerrits *et al.*, 1985). The scale of the problem is large, since at present in the UK about two million broilers are transported to slaughter each working day. The financial loss incurred as a result of injury and premature death during transportation is probably between £15 million and £30 million per annum (Kettlewell and Turner, (1985). In addition to the financial implications, the welfare of birds that are injured will be impaired and it is possible that the remainder may suffer varying degrees of stress.

Broilers are still generally caught by hand, inverted and carried by one leg in groups of 5 or 6 to the transport unit, usually some form of crate. Most 'transport damage' to the birds occurs during this catching and crating process (Gerrits *et al.*, 1985). One possible way of alleviating the catching and crating problem is to harvest the birds mechanically. Until recently, machines for this purpose have been based on principles similar to a combine harvester, with a horizontal, rotating, foam-rubber paddle sweeping birds on to a conveyor belt. Broilers going through these machines appear less stressed and the proportion of carcases down graded seems to be reduced (Anon, 1984).

A prototype machine based on different principles which allows more

manoeuvrability has been developed by the National Institute of Agricultural Engineering (Plate 1). The pick-up head consists of three rotors each fitted with soft rubber fingers. The rotors are fitted at the front of the machine with their axes almost vertical (Plate 2). The machine operates by moving slowly forward into a flock of broilers, scanning first to one side, then to the other, thus clearing a path much wider than the width of the machine. As the machine scans to the right, the central rotor and the right-hand rotor counter-rotate and birds are picked up gently by the soft rubber fingers and deposited on a sloping conveyor belt. When the machine scans to the left, the central rotor changes direction and counter-rotates with the left-hand rotor. The sloping conveyor belt moves the birds to the rear of the machine and raises them about 1 m above the floor. A system for placing birds in containers at the rear of the machine is in the process of being designed. At present only the scanning/pick-up/lifting part of the harvester has been developed and this was tested in the present study.

Field trials have shown that the machine is capable of collecting over 6 000 birds/h, but the need to take birds from the loading platform and put them manually into crates restricts this to about 4 500 birds/h. Preliminary results also suggest that the proportion of birds down graded after being harvested by the machine is markedly reduced compared with conventional catching methods.

The purpose of this investigation was to compare the stress imposed by both manual and mechanical pick-up methods. The sudden and intense changes in stimulation involved in catching and crating broilers are likely to lead to a state that is normally termed 'fear' which is a type of short-term stress (Duncan, 1981). Heart rate, which is a good physiological indicator of fear in the fowl (Duncan and Filshie, 1980), was recorded using radiotelemetry techniques (Filshie *et al.*, 1980). The extent of fearfulness was also determined behaviourally using duration of tonic immobility (Jones and Mills, 1983).

MATERIALS AND METHODS

One thousand 8-week-old broiler chickens were kept at one end of a deep litter house by a temporary partition, which created an area 6·0 × 7·5 m and maintained the birds at a commercial stocking density. The birds had previously taken part in a nutrition trial, they weighed approximately 2·5 kg and normal husbandry practices were applied. Twelve birds were chosen at random and implanted with radio-transmitters (Filshie *et. al.*, 1980), for the purpose of recording heart rate during the harvesting procedure. These test birds were marked with coloured dyes to enable them to be identified. They were returned to the flock and allowed 3 d to settle down before recording started. The experiment was carried out over a 4-d period; the first two were concerned with heart rate measurement and the second two with tonic immobility. Testing was carried out between 09.00 h and 14.00 h, during which time food and water were removed and lighting was reduced to an extremely low intensity.

Electrocardiogram recording

For heart rate recordings, all 12 implanted birds were harvested manually

and by machine, so each individual experienced both experimental conditions. On day 1, half the birds were harvested manually and the other half mechanically. On day 2, those that had already been harvested manually were machine harvested and vice-versa. The bird to be tested was chosen at random, and then located with a torch. Its electrocardiogram (ECG) signal was picked up on a VHF receiver via a dipole aerial held approximately 0·7 m above the bird's head throughout the recording. The ECG signal was recorded on magnetic tape and a commentary was recorded on another channel of the same tape. For mechanical harvesting the machine was switched on and the ECG signal was recorded for about a minute before the machine started moving towards the bird. Recording continued as the bird was picked up, along with others, travelled through the machine and was placed gently on the ground by an observer, where a further 2 min of recording was collected. The procedure for manual harvesting was similar except that the test bird was caught by the legs, inverted and carried upside down by one leg in a group of 5 birds over a distance equivalent to that covered by the conveyor belt within the machine. Although this procedure resembled commercial catching, it differed in that the birds were completely undisturbed until they were caught and were handled more gently.

Tonic immobility

On days 3 and 4, sixty birds were assessed for fearfulness using duration of tonic immobility (TI), which is an unlearned response, triggered by restraint and characterised by a catatonic-like state of reduced responsiveness which may last from minutes to hours (Nash and Gallup, 1976). The procedure involves restraining a bird on its back in a cradle, and measuring the time it takes for the bird to right itself (Jones and Faure, 1980). TI is considered to be a fear-potentiated response (Gallup, 1977).

The birds were selected at random from the flock, 30 on day 3 and 30 on day 4. Each bird was subjected to one of three treatments, 20 birds per treatment. The three treatments, carried out in a random order, were machine harvesting and manual harvesting, as described earlier, after which each bird was carried gently to a quiet side room where TI was induced, or a control treatment which consisted of gently carrying the bird straight to the side room and inducing TI. If a bird remained in TI for the 15-min test period, a maximum score of 900 s was recorded.

Statistical analysis

The ECG signals were transferred to a paper trace via a UV recorder and 5 s averages of heart rate were calculated. The least squares method was used to estimate constants and analysis of variance to test for significance of effects. A subsample of alternate points was also analysed to check for correlations between adjacent data points; these proved not to be too large when other effects such as individual bird effects were taken into account, suggesting that the data points were independent.

The durations of TI in the three conditions were firstly subjected to a one-way analysis of variance by ranks (Kruskal-Wallis test) to establish sources of variation. Secondly, differences between conditions were assessed using the Mann-Whitney *U* test.

RESULTS

Heart rate

The heart rate traces are shown in Fig. 1. The difference in pattern of response for the two different methods of harvesting was highly significant ($P<0{\cdot}001$). In the minute before harvesting, the birds which were going to be harvested by machine had higher heart rates than those that were going to be harvested by hand. Both traces rose to similar rates immediately after harvesting. However, the trace of the machine-harvested birds dropped more quickly and from 30 s afterwards the heart rate averages were significantly lower than those of the manually-harvested birds (*t* test; $P<0{\cdot}05$). After 2 min the trace from machine-harvested birds was approaching its pre-harvesting value. There was no evidence of a difference in pattern between the two testing days, but the mean heart rate for all birds was significantly lower on the second day (5·7 beats/min; $P<0{\cdot}01$). There was considerable variation in mean heart rate between different birds ($P<0{\cdot}001$).

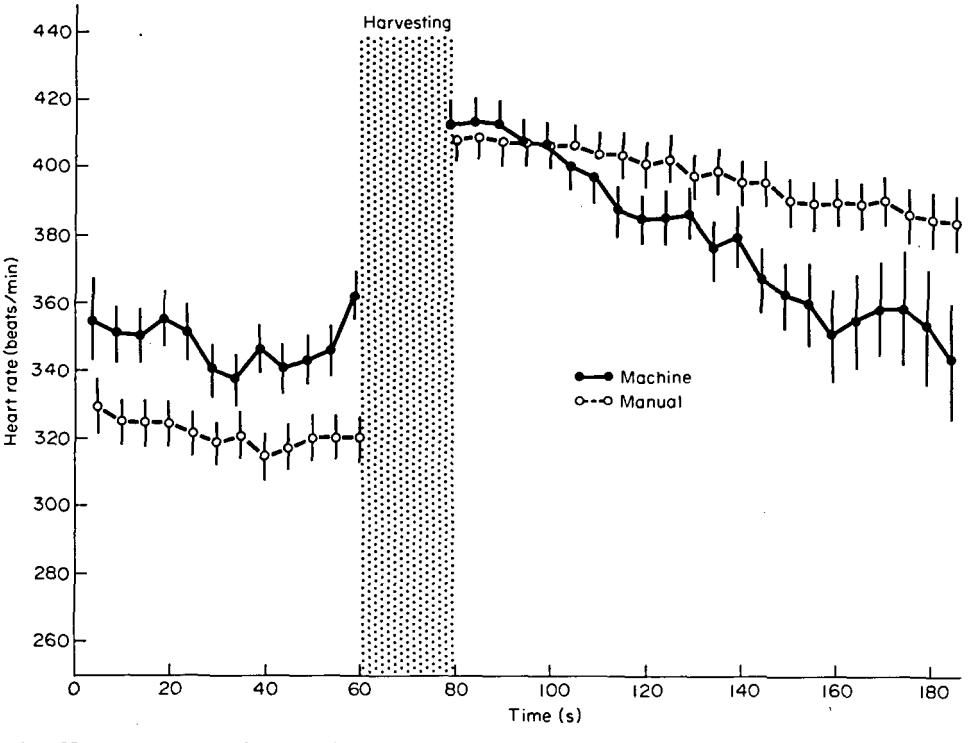

FIG. 1.—Heart rate traces for machine and manual harvesting. Five s averages ± SE are shown.

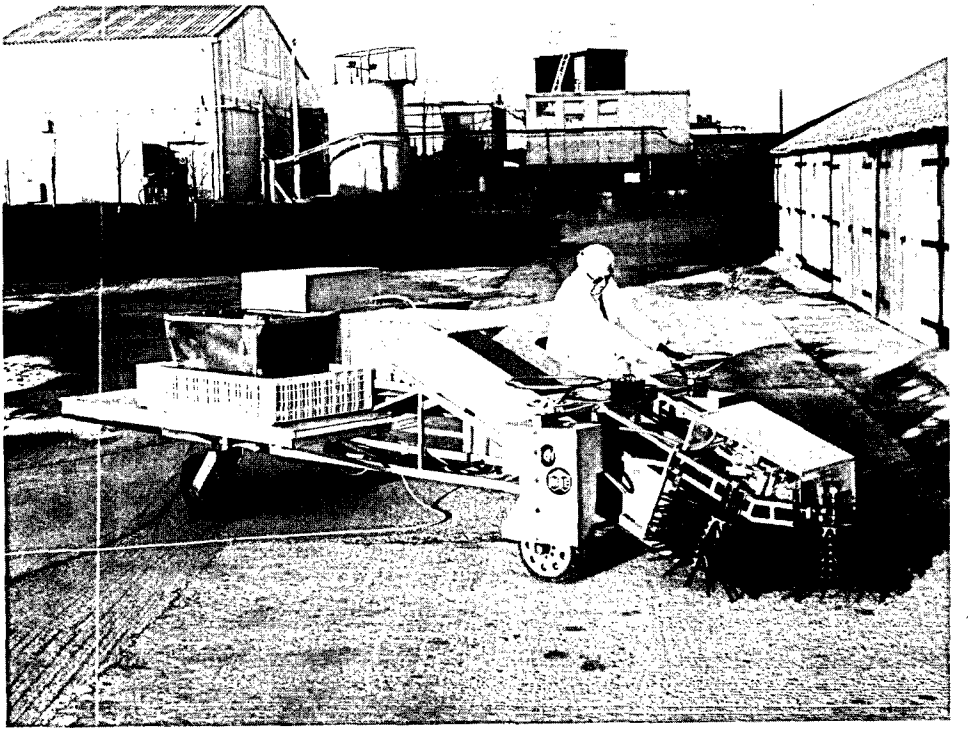

PLATE-FIG 1.—The prototype harvesting machine.

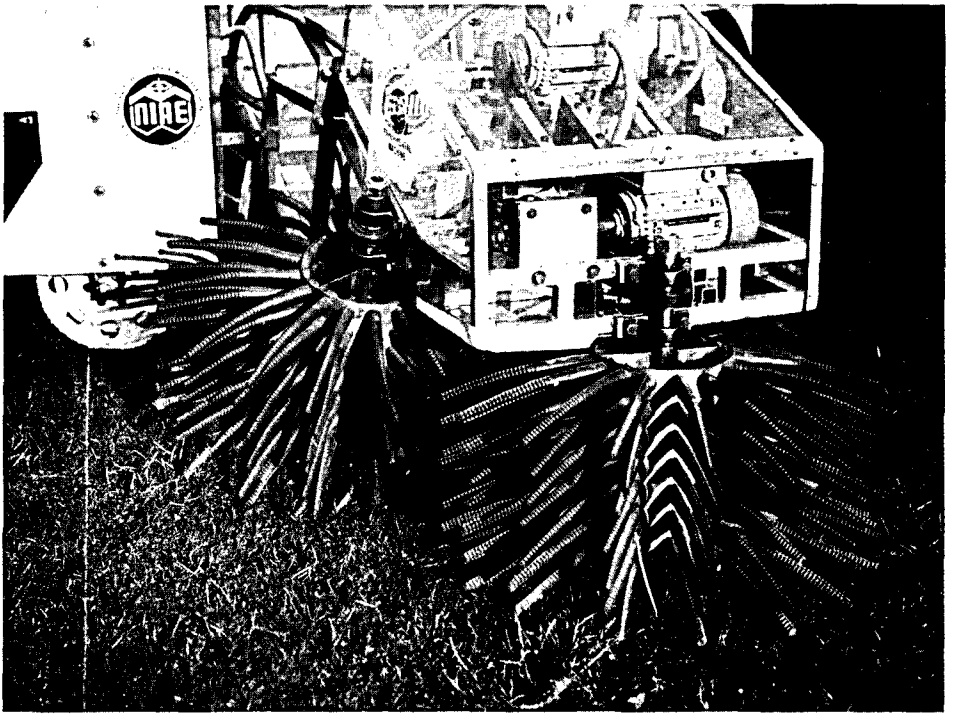

PLATE-FIG. 2—The three-rotor pick-up head showing the soft rubber fingers.

Tonic immobility

The durations of tonic immobility after the various treatments are shown in the Table. The differences between treatments were significantly greater than the differences within treatments (Kruskal-Wallis, $H=14{\cdot}38$; $P<0{\cdot}001$). Manual catching produced a significantly longer duration of TI than either machine (Mann-Whitney, $U=118$; $P<0{\cdot}05$) or control (Mann-Whitney, $U=125$; $P<0{\cdot}05$) treatments. There was no significant difference between machine and control treatments.

TABLE

Duration of tonic immobility (mean ± SE) after different methods of harvesting

Harvesting method	Number of birds	Duration (s)
Control	20	$332 \pm 50{\cdot}0^{a}$
Machine	19	$376 \pm 58{\cdot}8^{a}$
Manual	20	$639 \pm 59{\cdot}5^{b}$

Means with different superscript differ significantly $P<0{\cdot}05$

DISCUSSION

Both measures of short-term stress suggested that the birds were less frightened after being harvested by machine. The heart rate of machine harvested birds recovered more quickly and their duration of TI was much shorter.

The differences in heart rate before harvesting are probably due to differences in alertness; before being harvested by machine, the birds were subjected to the motor noise of the machine, whereas there was almost complete silence before manual catching. However, both traces are well within the range expected for active but non-frightened fowl (Duncan and Filshie, 1980; Jones *et al.*, 1981). For both catching treatments, the relatively small standard error of the mean rate immediately after harvesting probably indicates that this rate (about 410 beats/min) is near to the maximum physiologically-possible rate. It was similar to the rate observed when broilers were frightened by a very potent visual stimulus (Duncan and Filshie, 1980). The lower rate of decline for manually-harvested birds suggests that during harvesting there was a greater release of adrenaline, which took longer to be metabolised.

The differences in duration of TI were even more dramatic and suggested that the machine-caught birds were no more fearful than those treated as gently as possible by hand. Tonic immobility in the manually-caught birds lasted about twice as long, suggesting that they were much more frightened.

These results indicate that short-term stress associated with the catching of broiler chickens can be considerably reduced by using a carefully-designed machine instead of catching by hand. The other steps involved in the transportation and pre-slaughter management of broilers now need to be investigated in

order to find out whether or not they might also be improved in relation to stress and welfare.

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